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EXOMARS 2016 SCHIAPARELLI MISSION LESSON LEARNT LOOKING FORWARD TO THE EXOMARS 2020 DM MISSION

Abstract

ExoMars programme is part of a broad cooperation between ESA and Roscosmos with significant contributions from NASA. It consists of two missions to Mars that aim to searching for signs of past and present life on Mars, investigating the Martian atmosphere and surface and demonstrating the technologies needed to land on Mars and perform robotic exploration.

The first spacecraft composed of an Orbiter Module (the Trace Gas Orbiter, TGO) carrying an Entry descent and landing Demonstration Module (EDM) have been launched on 2016 March 14th by a Proton/Breeze-M launcher. The EDM called Schiaparelli in honor of the Italian scientist Giovanni Schiaparelli, famous for its studies on Mars, was released by the TGO on October 16th 2016 and reached the Martian soil three days after.

Despite Schiaparelli not having been in the condition to afford the soft landing, the GNC system of this mission is worth to be highlighted for the relevant number of aspects that where successfully demonstrated. Furthermore the outputs and the lessons learned of this mission are fundamental in view of the paramount milestone, in the Martian exploration, represented by the second ExoMars mission scheduled to be launched in 2020.

The first part of the paper focuses several aspects of the GNC design that were successfully proved in flight: the innovative logic invented to propagate the attitude solution across the 3 days period of hibernation, the inertial navigation of the complete state vector, the logics for detecting the Mars atmosphere interface entry point and for the parachute deployment. Also some other aspects, in particular the RDA processing and the RCS capability to track an attitude profile, later on compromised by the anomaly occurred at parachute inflation, are presented.

This anomaly is discussed in the second part of the paper, underlying the dramatic consequence of any prolonged gyro saturation for a GNC concept based on the data fusion, inside the local navigation, between rotation navigation estimated states and radar measurements.

Having in mind the need of extracting and implementing lessons to be learned for the incoming 2020 mission, the occurred failure in the Schiaparelli mission is therefore interesting to verify if possible alternative solutions are available, in a similar occurrence, to reset the attitude estimation on a complete different paradigm, discharging the nominal attitude solution carried out from the TGO separation. This problem is studied and some conclusions are therefore discussed in the third part of the paper.